Resonant Toxic Chemical Sensor Platform

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Resonant sensors consist of a resonator platform (quartz crystal microbalance, QCM) and a selective film sensitive to target chemical species (Fig 1). Mass induced changes upon exposure to the target chemical species result in resonant frequency shifts. We have targeted the detection of chemical and biological warfare agents. Silicon dioxide (SiO_2) was selected as an active film for detection of a nerve gas simulant, dimethyl-methylphosphonate (DMMP). Nano and micro-porous silicon dioxide films were applied to the QCM to insure enhanced sensitivity by application of a PMMA templating technique (Fig. 2). Fig. 3 shows the change in resonant frequency with repeated exposures to different partial pressures of DMMP and subsequent recovery in air thereby demonstrating the viability of using resonant sensors as a means of detecting chemical warfare agents.

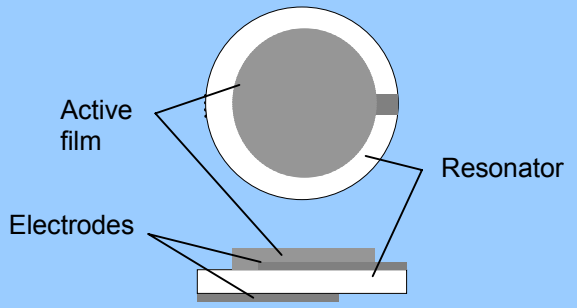

Fig 1

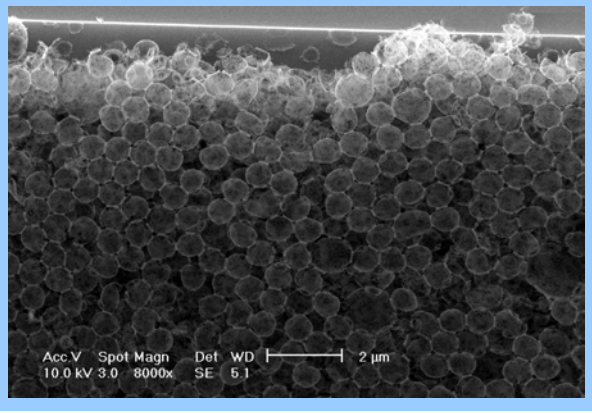

Fig 2

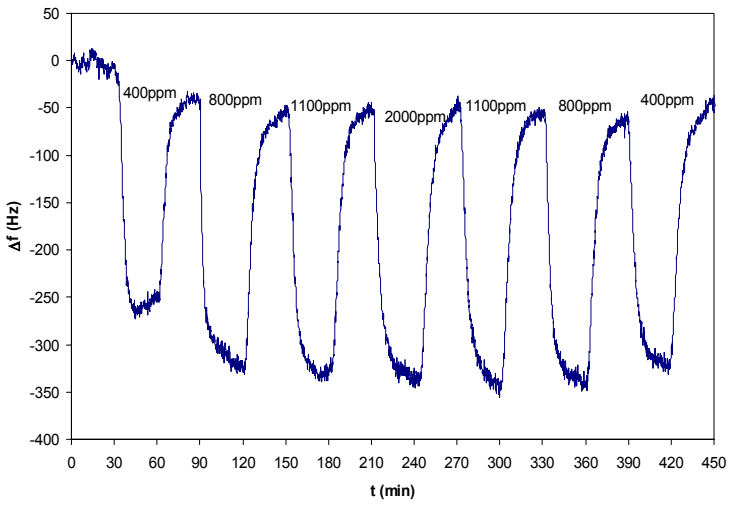

Fig 3

Students Gain Experience Across Disciplinary Boundaries

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This interdisciplinary program on sensing integrates concepts of surface chemistry and physics with engineering concepts related to high frequency resonant structures and their relevance to satisfying critical societal needs, i.e. securing safety from toxic chemicals. The project benefits from the close interaction of graduate and undergraduate students together with visiting scientists from Japan and Germany leading to the transfer of hands-on experimental knowledge as well as cultural differences.

Results relating to this work have been presented at many forums including the International Meeting on Chemical Sensors (Japan), the European Materials Research Society (France), the Asian Conf. Solid State Ionics (Korea) and the American Ceramic Society (Indianapolis). Students have co-authored six publications related to this work in 2003-2004.